## REMARKS

Claims 25-30, 32-37, and 39-66 are currently pending. Claims 25 and 30 have been amended. Claims 31 and 38 have been canceled. A clean copy of all pending claims as amended by this response is attached to this office action response.

IN THE CLAIMS:

Applicant focuses in this response on justifying the patentability of his independent claims 25 and 47. As the Examiner understands, if these broadest claims are patentable over the prior art, claims dependent thereon are necessarily also patentable, and hence discussion of the patentability of the dependent claims is unnecessary.

**A. Claim Rejections - Anticipation (35 U.S.C. § 102(e))**

The Examiner rejects independent claims 25 and 47 under 35 U.S.C. § 102(e) as being anticipated by Ogle et al. (U.S. Patent 6,233,374).

Applicant's claimed invention comprises two separate, although coupled, devices. Iindependent claim 25 (as amended) recites an acoustic sensing device for providing an acoustic signal that is indicative of the "speed of sound in the fluid flowing within the pipe," and a flow velocity sensing device for providing a velocity signal that is indicative of the "speed of the fluid flowing within the pipe." Independent claim 47 (not amended) similarly recites that the acoustic sensing device provides an "acoustic signal indicative of the speed of sound in the fluid," and the flow velocity sensing device provides a "velocity signal indicative of the velocity of the fluid flowing in the pipe."

These highlighted limitations are not disclosed or suggested by Ogle, and hence Ogle cannot render Applicant's claims unpatentable. Referring to Figure 1 of Ogle, the portion cited

by the Examiner, a fiber optic cable 13 is helically wound around a mandrel 10 to form a pressure sensor 5 that measures the average dynamic pressures external to the mandrel. *See* column 5, lines 8-10. However, this sensor does not provide a signal that is indicative of the speed of sound in the fluid flowing within the mandrel, nor does it provide a signal indicative of the speed of the fluid flowing within the mandrel as Applicant claims. First, it should be noted that Ogle expressly discusses the measurement of pressures <u>outside</u> of the mandrel. Although embodiments other than Figure 1 disclose some ability to allow fluid within the mandrel to "gradually distribute," see col. 7, ll. 38, fluid does not flow within the mandrel, and certainly it is not the function of sensor 5 to measure the speed of sound in the fluid or the speed at which the fluid flows or to provide signals indicative of these parameters. Indeed, the gradual helix disclosed in Ogle, which functions expressly to distribute forces presented to the mandrel, would seem incapable of measuring these parameters, and hence could not provide Applicant's claimed signals. In any event, the Examiner has overlooked that two devices are claimed to perform the measuring of these parameters; the Examiner cites only to sensor 5, which is not two separate, coupled devices each providing signal as Applicant claims.

Accordingly, Ogle does not disclose or suggest all of the limitations of Applicant's claims, and therefore cannot anticipate (or render obvious) Applicant's claims.

**B. Claim Rejections - Obviousness (35 U.S.C. § 103(a))**

The Examiner rejects independent claims 25 and 47 under 35 U.S.C. § 103(a) as being unpatentable over Berthold et al. (U.S. Patent 5,845,033) in view of Kluth (U.S. Patent 5,804,713).

Berthold discloses a system of fiber optic sensor cables 12 to measure hoop strain on the outside of the pipes 10 at multiple points along the production system. Col. 2, lines 63-66. The

hoop strain measured by the cables 12 is affected by "changes in internal pressure such as occurs when parafines, asphaltenes, scales, or hydrates build-up on the inside surface of the pipe." Col. 2, lines 66-67 through col. 3, line 1. This enables the system of Berthold to detect blockages within the pipe. Col. 6, lines 49-50.

Kluth discloses an apparatus for the installation of optical sensors in channels for providing measurements designed to locate and track fluid fronts within the reservoir and measurements for seismic interrogation on the rock strata within the reservoir. Col. 1, lines 4-11. Focusing on the portion of Kluth cited by the Examiner, Kluth deploys a linear array of fiber optic hydrophone along the production pipe to a coiled position in a control line affixed to the production pipe. Col. 4, ll. 44-49 & col. 3, ll. 47-49. This arrangement allows for sand detection, pump monitoring and fluid monitoring in the reservoir, and seismology analysis of the reservoir. Col. 4, ll. 52-58.

Like Ogle, neither Berthold nor Kluth disclose or two separate, coupled devices for providing signals indicative of the speed of the fluid flowing within the pipe or indicative of the velocity of the fluid flowing in the pipe. Indeed, neither of these references disclose the attainment of either of these signals as Applicant claims. Berthold provides a pressure signal indicative of internal pipe pressure. Given the great spacing of the sensors in Berthold, it is difficult to see how information could be attained to form such Applicant's claimed signals. (Berthold discloses formation of a sensor every 900 feet along the pipe being monitored, see col. 3, ll. 52-53, which would be insufficient to detect the speed of sound in the fluid or the speed at which the fluid flows in the pipe). The same can be said for Kluth: deploying of hydrophones may provide strata information as Kluth discloses, but this design does not enable one to

determine the speed of sound in the fluid in the pipe or the speed at which fluid is flowing in the pipe.

In short, neither Berthold nor Kluth disclose Applicant's claimed signals and it seems technically unfeasible for their disclosures to even produce such signals. Moreover, neither device discloses two separate, coupled devices for providing these signals. Because the signals claimed by the Applicant are not disclosed or suggested in Berthold or Kluth, they cannot render Applicant's claims unpatentable for obviousness even when taken in combination. See MPEP 2143.

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The Examiner is invited to contact the undersigned attorney at 713-787-1499 with any questions, comments or suggestions relating to this patent application.

Respectfully submitted,

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## APPENDIX: CLEAN COPY OF PENDING CLAIMS

1-24. (Canceled)

25. (Currently amended): An apparatus for sensing fluid flow within a pipe, comprising:

an acoustic sensing device for providing an acoustic signal indicative of the speed of sound in the fluid flowing within the pipe, wherein the acoustic device is attached to the outside wall of the pipe; and

a flow velocity sensing device coupled to the acoustic device for providing a velocity signal indicative of the speed of the fluid flowing within the pipe, wherein the flow device is attached to the outside wall of the pipe.

26. (Previously added): The apparatus of claim 25, further comprising an optical source optically connected to the apparatus for providing optical power to the acoustic sensing device and the flow velocity sensing device.

27. (Previously added): The apparatus of claim 25, further comprising a housing attached to the pipe for enclosing the sensing devices.

28. (Previously added): The apparatus of claim 27, wherein the housing comprises a pressure vessel.

29. (Previously added): The apparatus of claim 27, wherein the housing is filled with air, nitrogen, or argon.

30. (Currently amended): The apparatus of claim 25, wherein the pipe is sufficiently compliant so that the sensing devices may sense the speed of sound in the fluid and the speed of the fluid through the wall of the pipe.

31. (Canceled)

32. (Previously added): The apparatus of claim 25, wherein the acoustic sensing device comprises a plurality of sensors.

33. (Previously added): The apparatus of claim 32, wherein the sensors are spaced equidistantly apart.

34. (Previously added): The apparatus of claim 32, wherein the sensors are spaced to sense acoustic pressure variations traveling at the speed of sound in the fluid.

35. (Previously added): The apparatus of claim 32, wherein the sensors comprise optical fiber sensors.

36. (Previously added): The apparatus of claim 35, wherein each sensor comprises at least one coil of optical fiber wrapped around the circumference of the pipe.

37. (Previously added): The apparatus of claim 36, wherein each sensor is separated by at least one fiber Bragg grating.

38. (Canceled)

39. (Previously added): The apparatus of claim 25, wherein the flow velocity sensing device comprises a plurality of sensors.

40. (Previously added): The apparatus of claim 39, wherein the sensors are spaced equidistantly apart.

41. (Previously added): The apparatus of claim 39, wherein the sensors are spaced to sense local pressure variations traveling with the fluid in the pipe.

42. (Previously added): The apparatus of claim 39, wherein the sensors comprise optical fiber sensors.

43. (Previously added): The apparatus of claim 42, wherein each sensor comprises at least one coil of optical fiber wrapped around the circumference of the pipe.

44. (Previously added): The apparatus of claim 43, wherein each sensor is separated by at least one fiber Bragg grating.

45. (Previously added): The apparatus of claim 25, wherein the acoustic sensing device and the flow velocity sensing device are coupled by a fiber optic cable.

46. (Previously added): The apparatus of claim 25, wherein the acoustic sensing device and the flow velocity sensing device are multiplexed along a common fiber optic cable.

47. (Previously added): An apparatus for sensing fluid flow within a pipe, comprising:

an acoustic sensing device to sense acoustic pressure variations traveling at the speed of sound in the fluid, the acoustic sensing device providing an acoustic signal indicative of the speed of sound in the fluid; and

a flow velocity sensing device to sense local pressure variations traveling with the fluid, the flow velocity sensing device providing a velocity signal indicative of the velocity of the fluid flowing in the pipe.

48. (Previously added): The apparatus of claim 47, further comprising an optical source optically connected to the apparatus for providing optical power to the acoustic sensing device and the flow velocity sensing device.

49. (Previously added): The apparatus of claim 47, further comprising a housing attached to the pipe for enclosing the sensing devices.

50. (Previously added): The apparatus of claim 49, wherein the housing comprises a pressure vessel.

51. (Previously added): The apparatus of claim 49, wherein the housing is filled with air, nitrogen, or argon.

52. (Previously added): The apparatus of claim 47, wherein the pipe is sufficiently compliant so that the sensing devices may sense the acoustic pressure variations and the local pressure variations through the wall of the pipe.

53. (Previously added): The apparatus of claim 47, wherein the acoustic sensing device comprises a plurality of sensors.

54. (Previously added): The apparatus of claim 53, wherein the sensors are spaced equidistantly apart.

55. (Previously added): The apparatus of claim 53, wherein the sensors are spaced to sense acoustic pressure variations traveling at the speed of sound in the fluid.

56. (Previously added): The apparatus of claim 53, wherein the sensors comprise optical fiber sensors.

57. (Previously added): The apparatus of claim 56, wherein each sensor comprises at least one coil of optical fiber wrapped around the circumference of the pipe.

58. (Previously added): The apparatus of claim 57, wherein each sensor is separated by at least one fiber Bragg grating.

59. (Previously added): The apparatus of claim 47, wherein the flow velocity sensing device comprises a plurality of sensors.

60. (Previously added): The apparatus of claim 59, wherein the sensors are spaced equidistantly apart.

61. (Previously added): The apparatus of claim 59, wherein the sensors are spaced to sense local pressure variations traveling with the fluid in the pipe.

62. (Previously added): The apparatus of claim 59, wherein the sensors comprise optical fiber sensors.

63. (Previously added): The apparatus of claim 62, wherein each sensor comprises at least one coil of optical fiber wrapped around the circumference of the pipe.

64. (Previously added): The apparatus of claim 63, wherein each sensor is separated by at least one fiber Bragg grating.

65. (Previously added): The apparatus of claim 47, wherein the acoustic sensing device and the flow velocity sensing device are coupled by a fiber optic cable.

66. (Previously added): The apparatus of claim 47, wherein the acoustic sensing device and the flow velocity sensing device are multiplexed along a common fiber optic cable.